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(54) **SYSTEM AND METHOD FOR INTEGRATING VOICE WITH A MEDICAL DEVICE**

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A61B 5/00 (2006.01)

(52) **U.S. Cl.** **600/509**; 600/481; 600/300; 704/275

(58) **Field of Classification Search** 600/300, 600/301, 513, 509, 508, 523, 483, 532; 128/903, 128/904, 920; 340/573.1, 539.11; 725/116; 705/3, 2; 700/242; 704/270, 275
See application file for complete search history.

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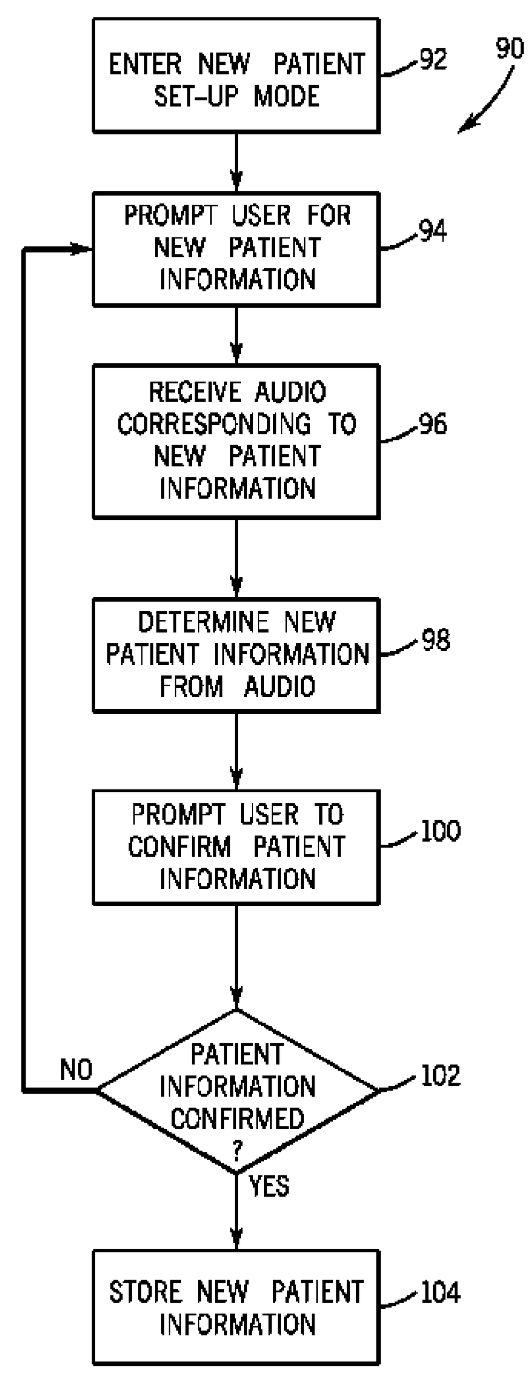
Primary Examiner — Vijay B Chawan

(57) **ABSTRACT**

There is provided a system and method for integrating voice with a medical device. More specifically, in one embodiment, there is provided a medical device comprising a speech recognition system configured to receive a processed voice, compare the processed voice to a speech database, identify a command for the medical device corresponding to the processed voice based on the comparison, and execute the identified medical device command.

26 Claims, 7 Drawing Sheets



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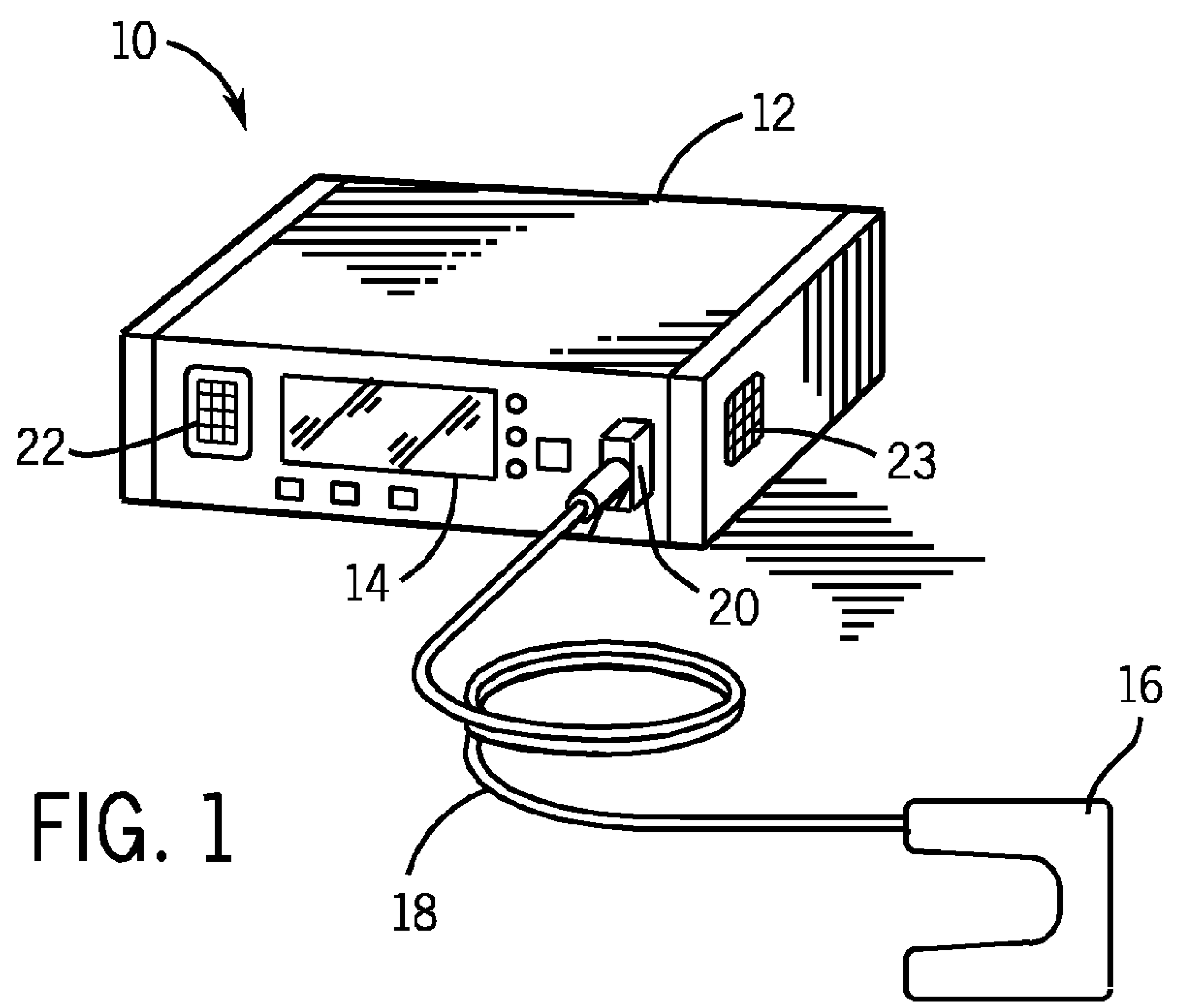


FIG. 1

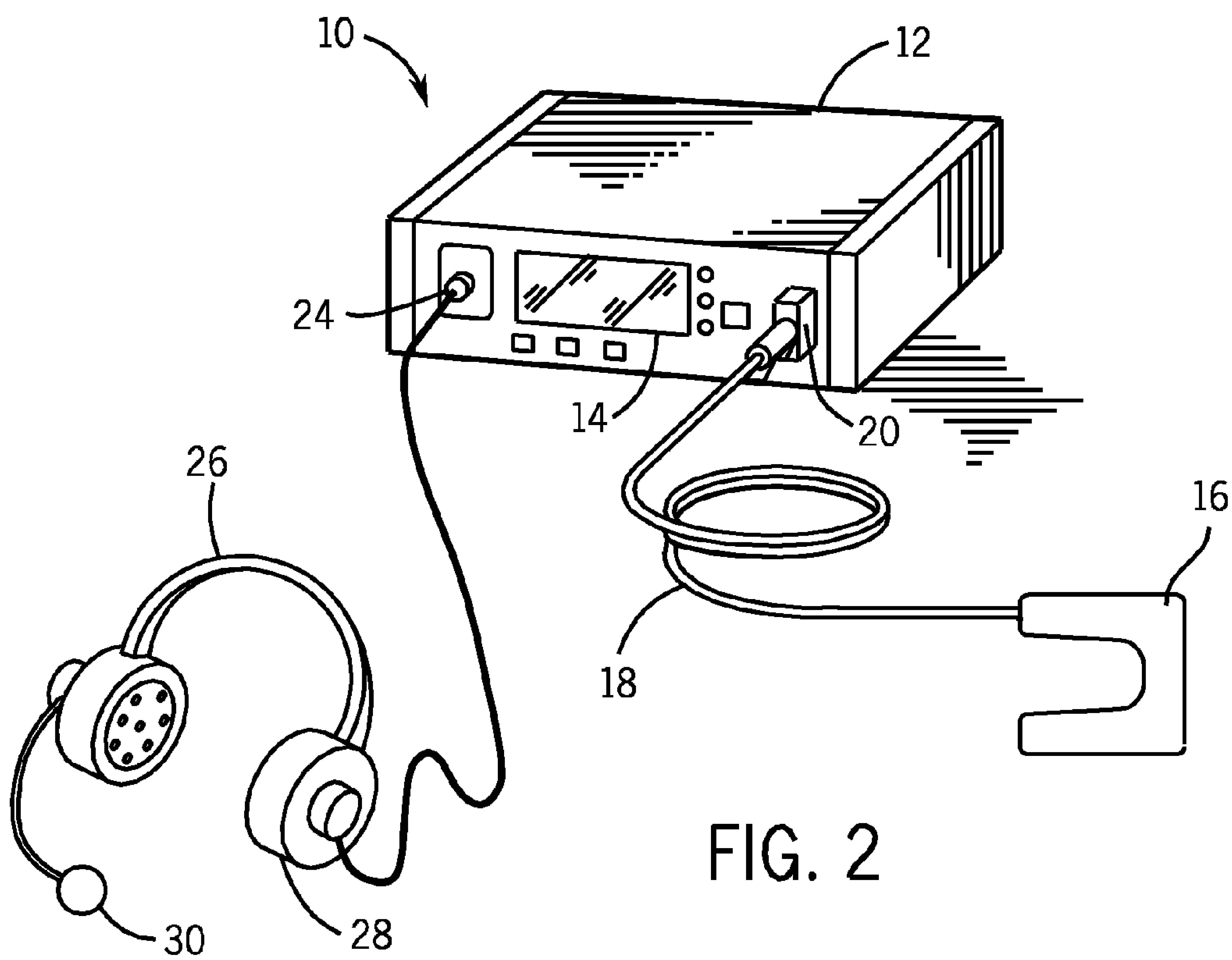


FIG. 2

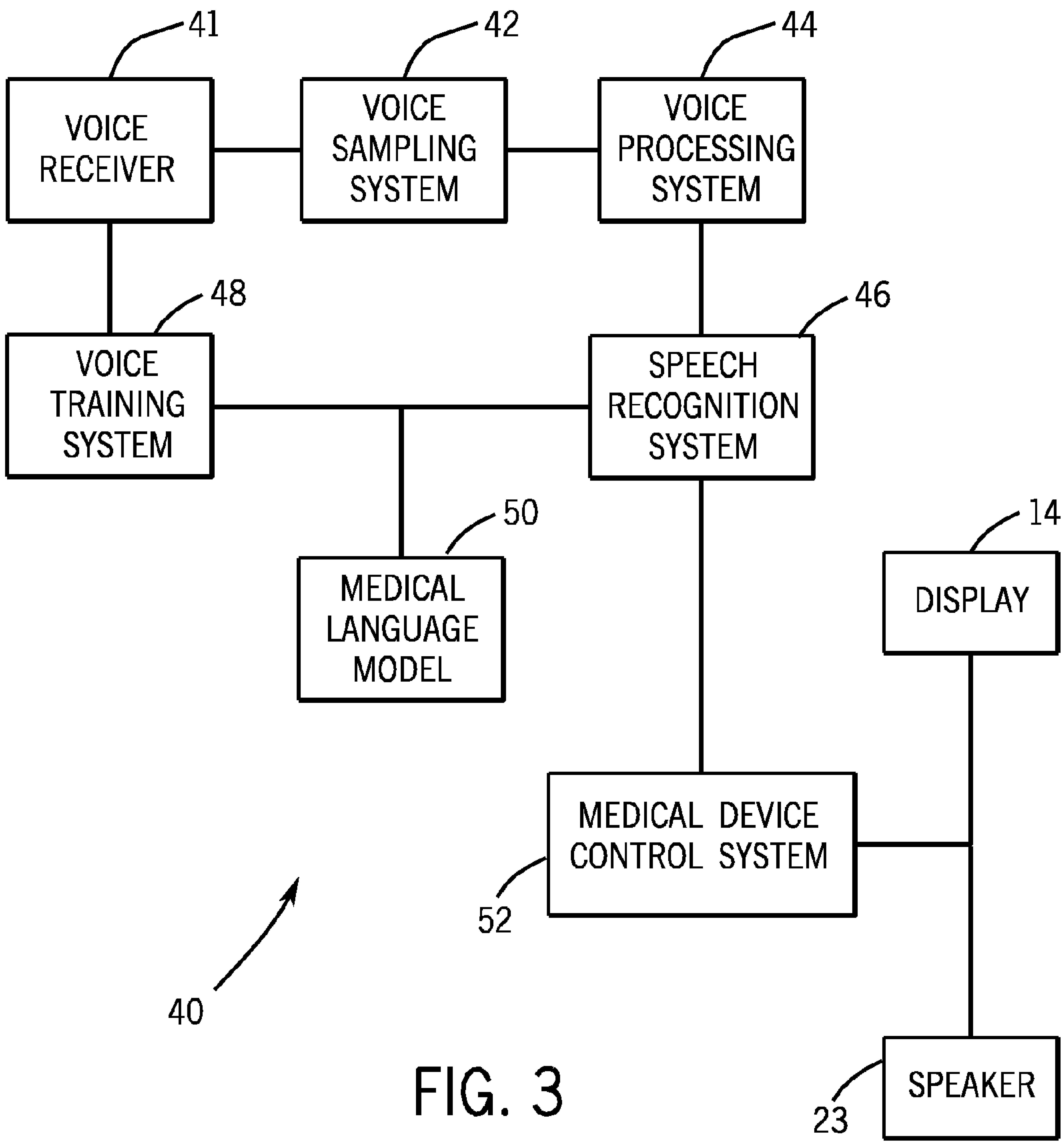
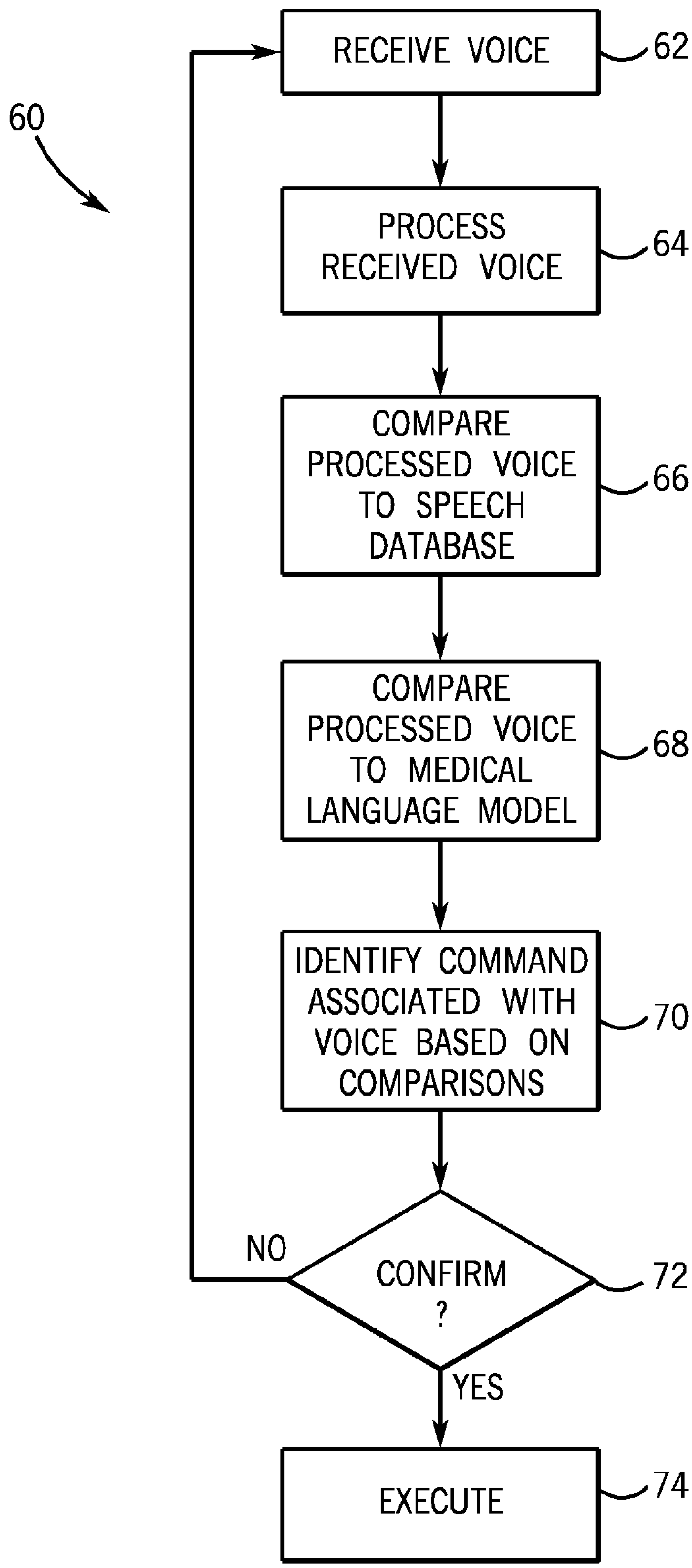

41
VOICE RECEIVER
42
VOICE SAMPLING SYSTEM
44
VOICE PROCESSING SYSTEM
48
VOICE TRAINING SYSTEM
46
SPEECH RECOGNITION SYSTEM
50
MEDICAL LANGUAGE MODEL
14
DISPLAY
MEDICAL DEVICE CONTROL SYSTEM
52
40
SPEAKER
23

FIG. 3



60
RECEIVE VOICE
62
PROCESS RECEIVED VOICE
64
COMPARE PROCESSED VOICE TO SPEECH DATABASE
66
COMPARE PROCESSED VOICE TO MEDICAL LANGUAGE MODEL
68
IDENTIFY COMMAND ASSOCIATED WITH VOICE BASED ON COMPARISONS
70
NO
CONFIRM ?
72
YES
EXECUTE
74

FIG. 4

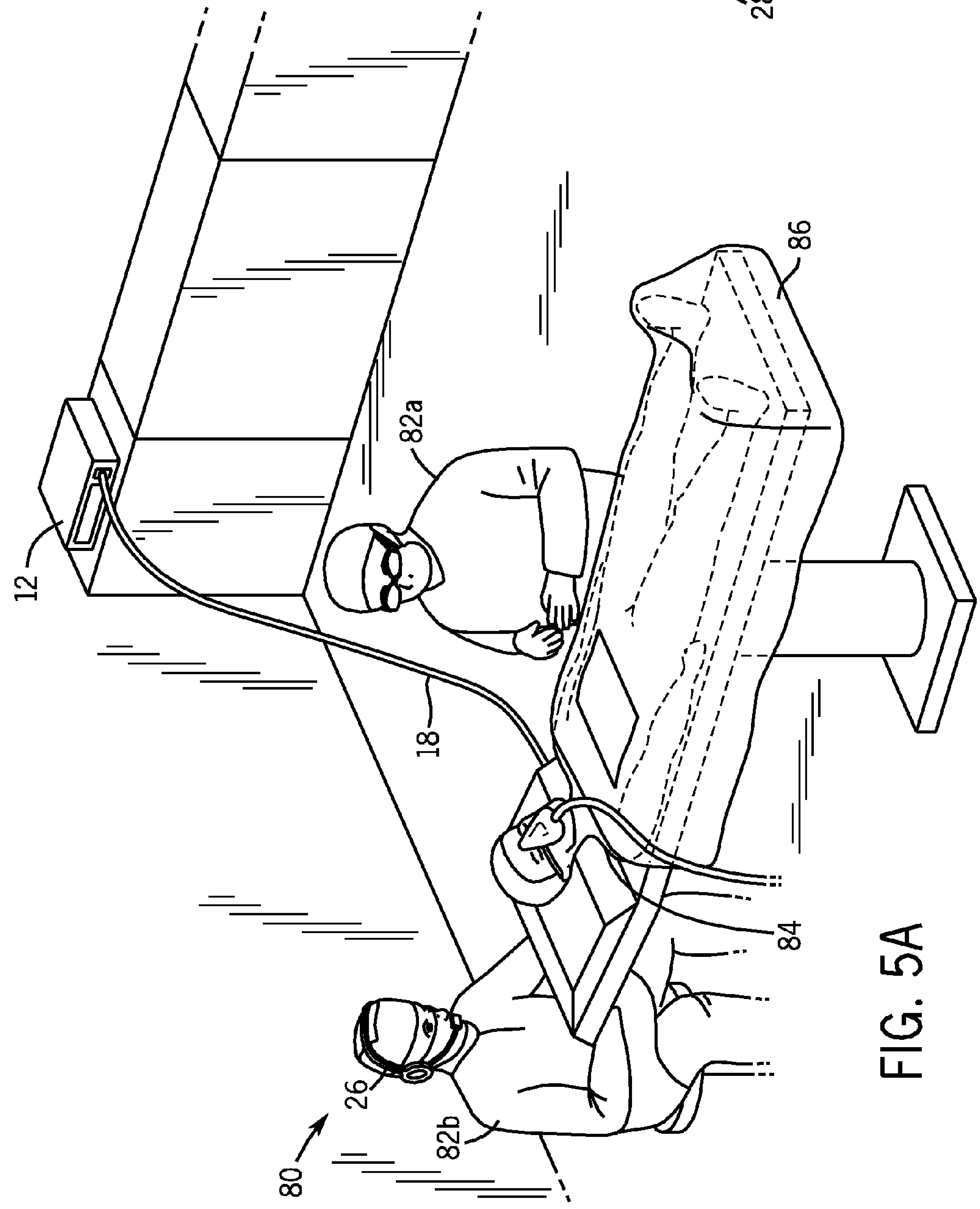


FIG. 5A

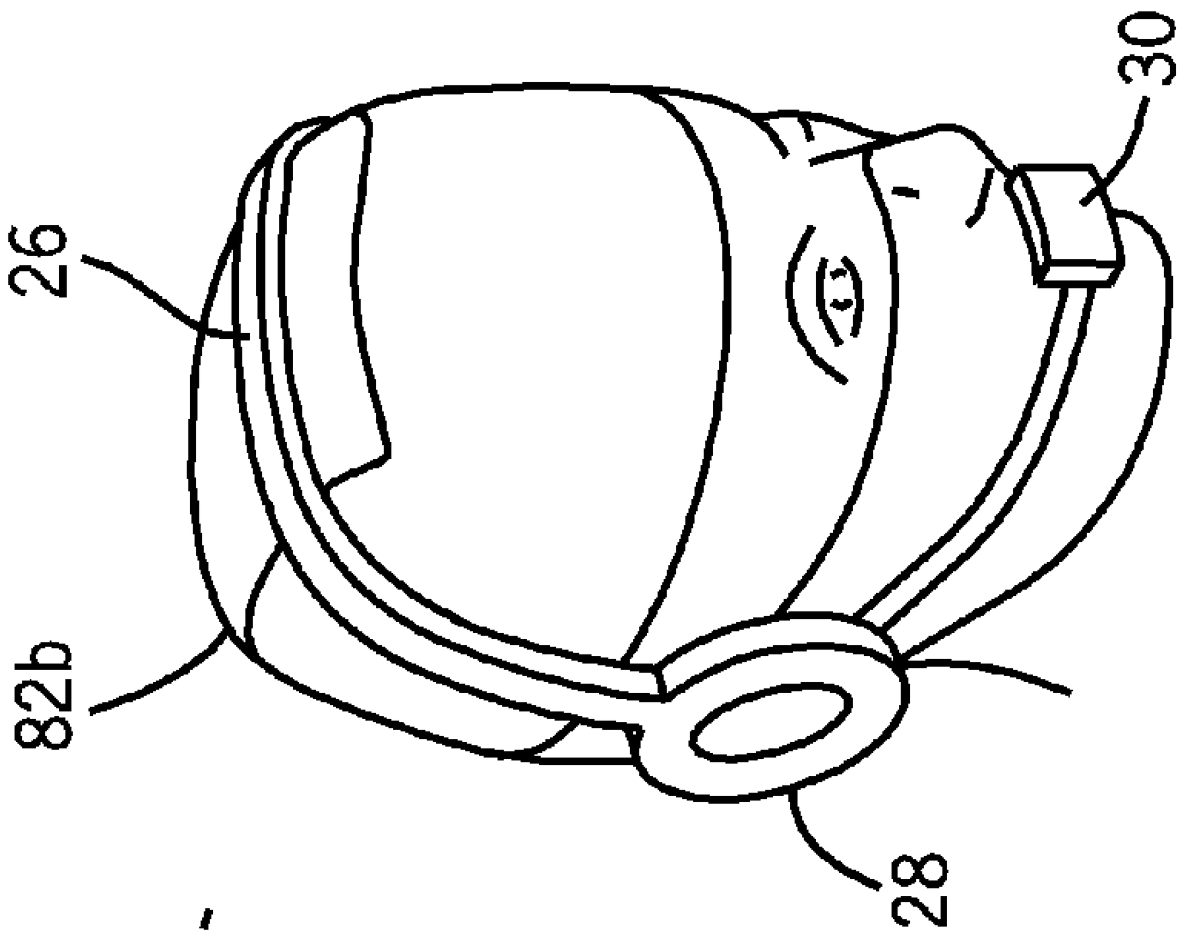


FIG. 5B

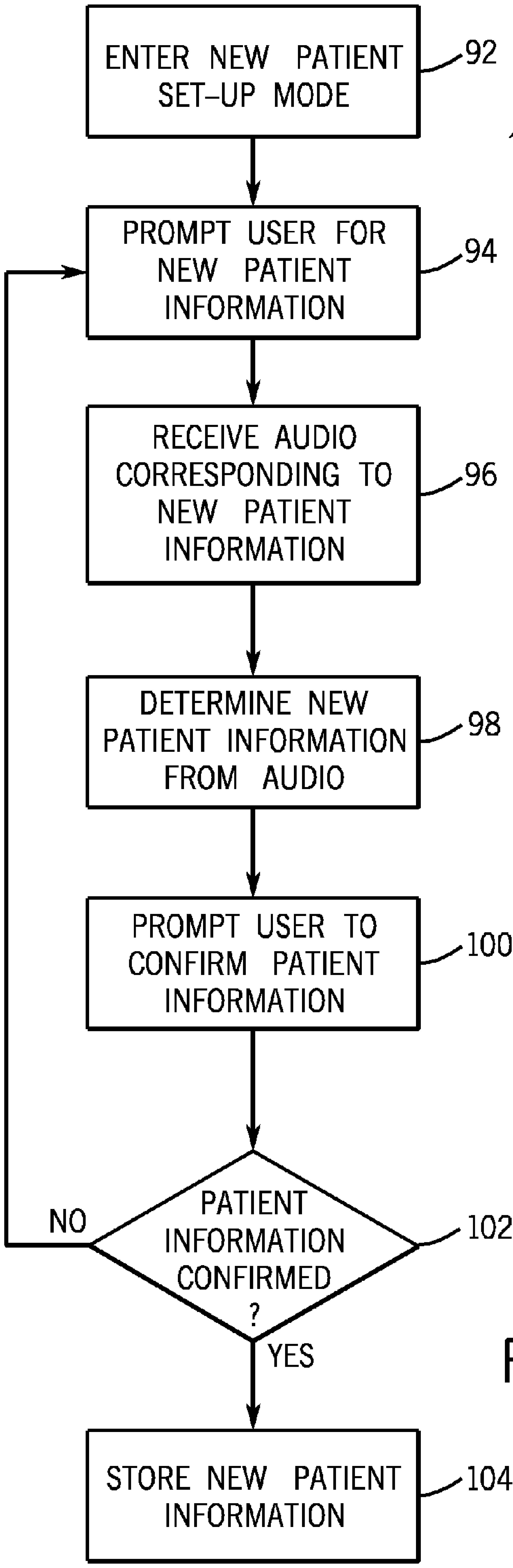

90
ENTER NEW PATIENT SET-UP MODE
92
PROMPT USER FOR NEW PATIENT INFORMATION
94
RECEIVE AUDIO CORRESPONDING TO NEW PATIENT INFORMATION
96
DETERMINE NEW PATIENT INFORMATION FROM AUDIO
98
PROMPT USER TO CONFIRM PATIENT INFORMATION
100
PATIENT INFORMATION CONFIRMED ?
102
NO
YES
STORE NEW PATIENT INFORMATION
104

FIG. 6

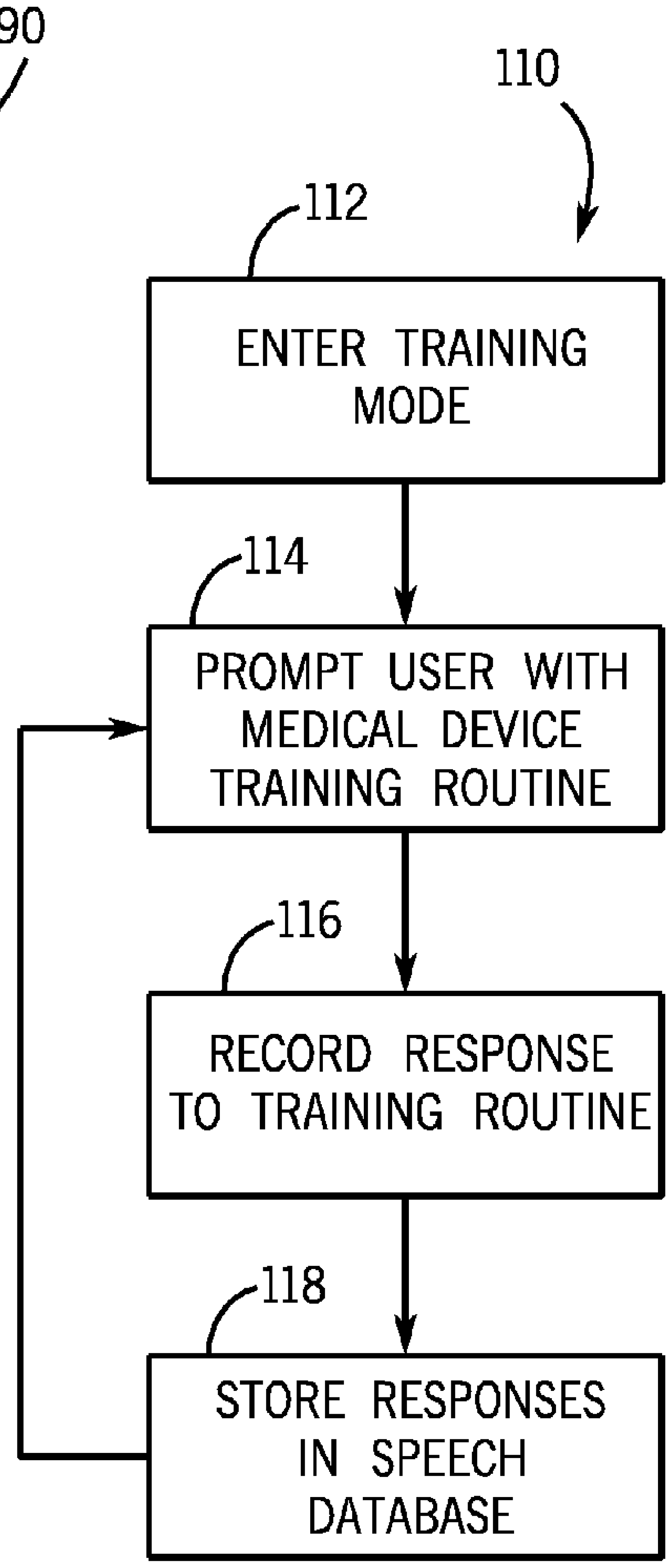

110
112
ENTER TRAINING MODE
114
PROMPT USER WITH MEDICAL DEVICE TRAINING ROUTINE
116
RECORD RESPONSE TO TRAINING ROUTINE
118
STORE RESPONSES IN SPEECH DATABASE

FIG. 7

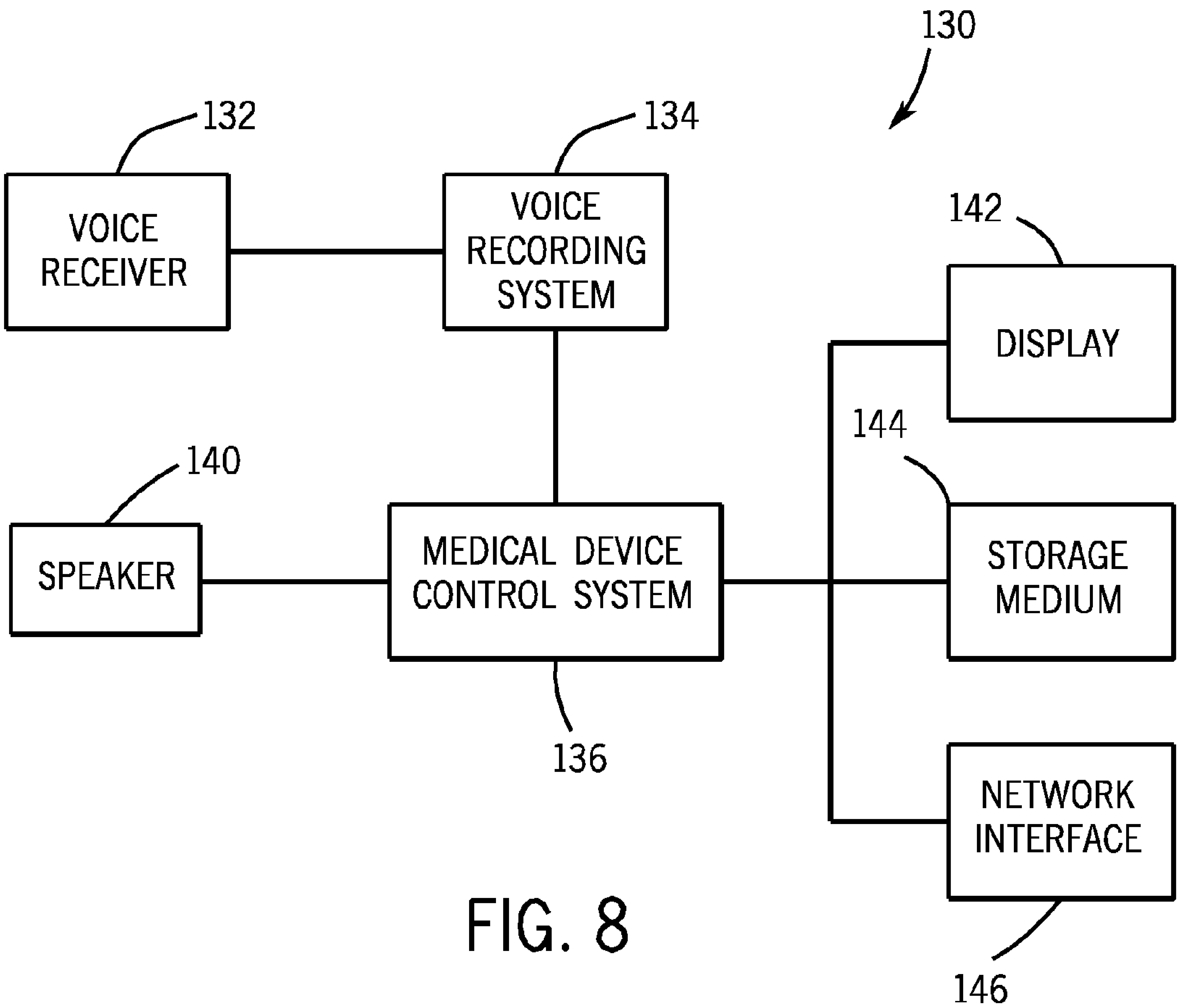

130
132
VOICE RECEIVER
134
VOICE RECORDING SYSTEM
142
DISPLAY
144
140
SPEAKER
MEDICAL DEVICE CONTROL SYSTEM
STORAGE MEDIUM
136
NETWORK INTERFACE
146

FIG. 8

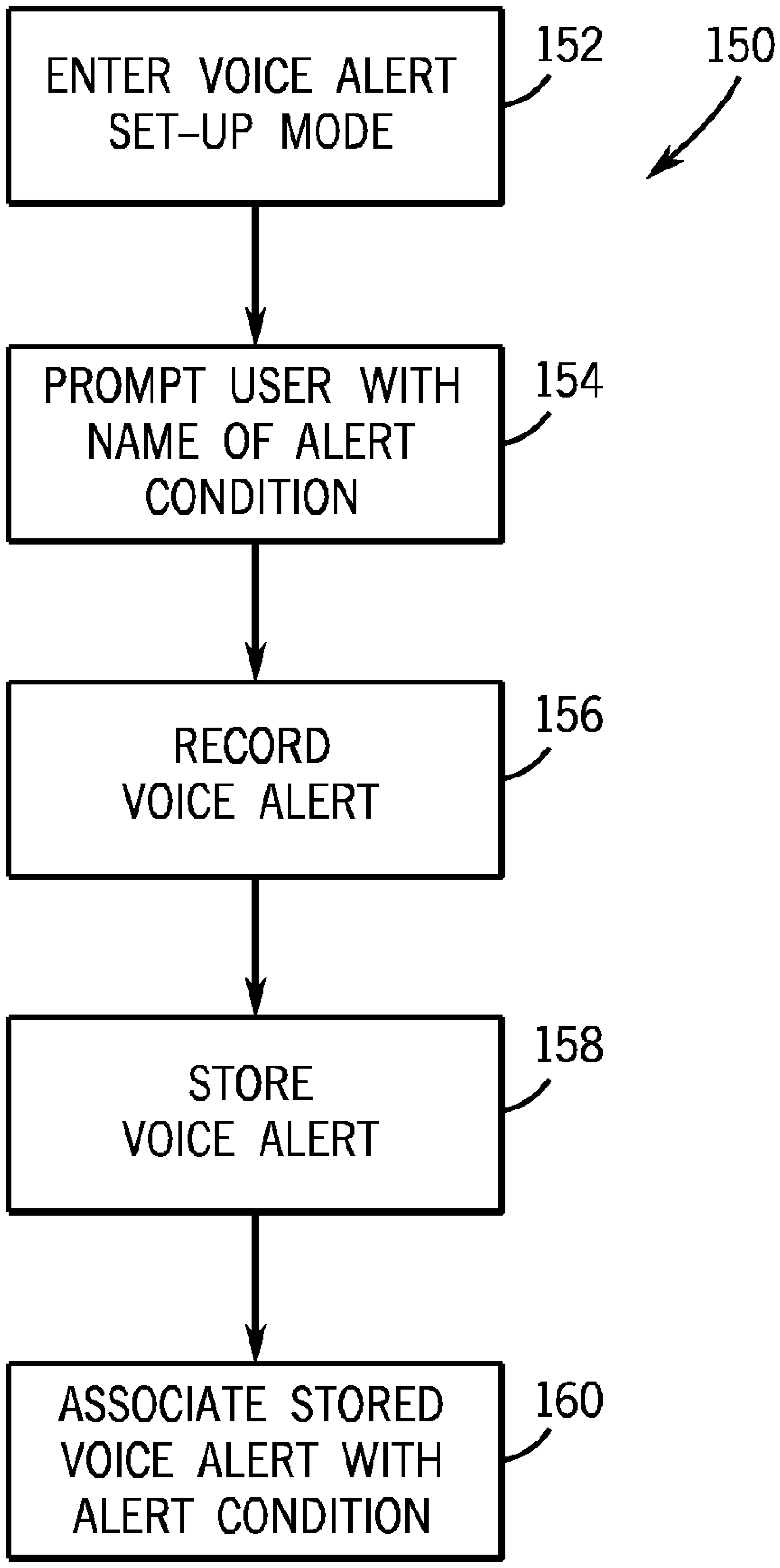

ENTER VOICE ALERT SET-UP MODE
152
150
PROMPT USER WITH NAME OF ALERT CONDITION
154
RECORD VOICE ALERT
156
STORE VOICE ALERT
158
ASSOCIATE STORED VOICE ALERT WITH ALERT CONDITION
160

FIG. 9

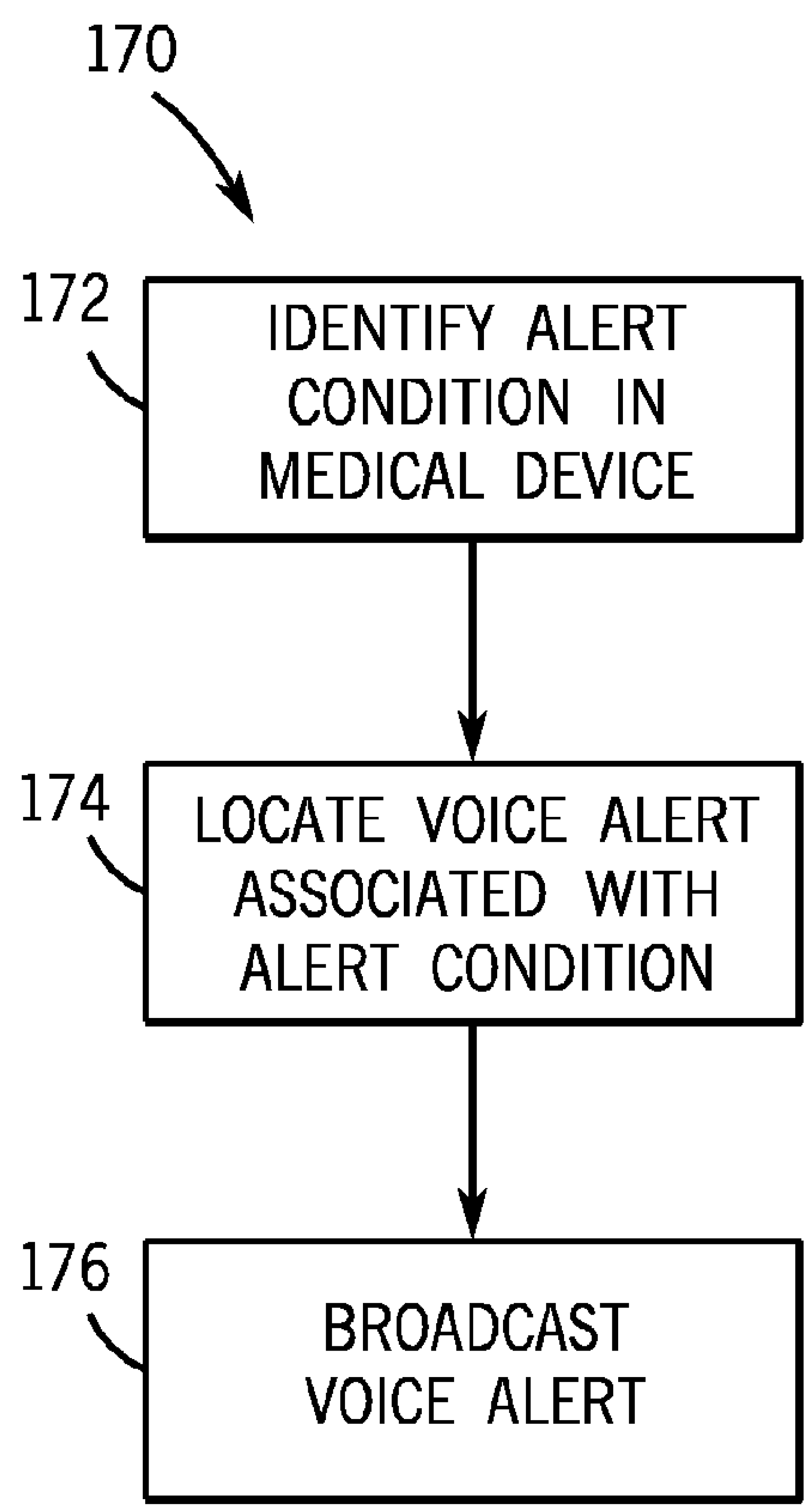

170
IDENTIFY ALERT CONDITION IN MEDICAL DEVICE
172
LOCATE VOICE ALERT ASSOCIATED WITH ALERT CONDITION
174
BROADCAST VOICE ALERT
176

FIG. 10

SYSTEM AND METHOD FOR INTEGRATING VOICE WITH A MEDICAL DEVICE

CROSS-REFERENCES TO RELATED APPLICATION

This application is a continuation of U.S. patent application Ser. No. 11/540,457 filed on Sep. 29, 2006.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to medical devices and, more particularly, to integrating voice controls and/or voice alerts into the medical device.

2. Description of the Related Art

This section is intended to introduce the reader to various aspects of art that may be related to various aspects of the present invention, which are described and/or claimed below. This discussion is believed to be helpful in providing the reader with background information to facilitate a better understanding of the various aspects of the present invention. Accordingly, it should be understood that these statements are to be read in this light, and not as admissions of prior art.

In the field of medicine, doctors often desire to monitor certain physiological characteristics of their patients. Accordingly, a wide variety of devices have been developed for monitoring physiological characteristics. Such devices provide cargivers, such as doctors, nurses, and/or other healthcare personnel, with the information they need to provide the best possible healthcare for their patients. As a result, such monitoring devices have become an indispensable part of modern medicine.

For example, one technique for monitoring certain physiological characteristics of a patient is commonly referred to as pulse oximetry, and the devices built based upon pulse oximetry techniques are commonly referred to as pulse oximeters. Pulse oximetry may be used to measure various blood flow characteristics, such as the blood-oxygen saturation of hemoglobin in arterial blood, the volume of individual blood pulsations supplying the tissue, and/or the rate of blood pulsations corresponding to each heartbeat of a patient.

Pulse oximeters and other medical devices are typically mounted on stands that are positioned around a patient's bed or around an operating room table. When a caregiver desires to command the medical device (e.g., program, configure, and so-forth) they manipulate controls or push buttons on the monitoring device itself. The medical device typically provides results or responses to commands on a liquid crystal display ("LCD") screen mounted in an externally visible position within the monitoring device.

This conventional configuration, however, has several disadvantages. First, as described above, this conventional configuration relies upon physical contact with the monitoring device to input commands (e.g., pushing a button, turning a knob, and the like). Such physical contact, however, raises several concerns. Among these concerns are that in making contact with the medical device, the caregiver may spread illness or disease from room to room. More specifically, a caregiver may accidentally deposit germs (e.g., bacteria, viruses, and so forth) on the medical device while manipulating the device's controls. These germs may then be spread to the patient when a subsequent caregiver touches the medical device and then touches the patient. Moreover, if the medical device is moved from one patient room to another, germs transferred to the medical device via touch may be carried from one patient room to another. Even in operating rooms where medical devices are typically static, germs may be transferred onto a medical device during one surgery and subsequently transferred off the medical device during a later performed surgery.

Second, beyond contamination, monitoring devices that rely on physical contact for command input may clutter the caregiver's workspace. For example, because the medical device must be within an arm's length of the caregiver, the medical device may crowd the caregiver—potentially even restricting free movement of the caregiver. In addition, caregivers may have difficulty manipulating controls with gloved hands. For example, it may be difficult to grasp a knob or press a small button due to the added encumbrance of a latex glove.

Third, current trends in general medical device design focus on miniaturizing overall medical device size. However, as controls which rely on physical contact must be large enough for most, if not all, caregivers to manipulate with their hands, medical devices that employ these types of controls are limited in their possible miniaturization. For example, even if it were possible to produce a conventional oximeter that was the size of a postage stamp, it would be difficult to control this theoretical postage stamp-sized pulse oximeter with currently available techniques.

In addition, conventional techniques for outputting medical data also have several potential drawbacks. For example, as described above, conventional techniques for displaying outputs rely on LCD screens mounted on the medical device itself. Besides constantly consuming power, these LCD screens must be large enough to be visually accessed by a doctor or nurse. As such, the conventional LCD screens employed in typical medical devices also may be a barrier towards miniaturization of the medical device. Further, conventional screen-based output techniques may be impersonal to the patient and may lack configurability by the caregiver.

For at least the reasons set forth above, an improved system or method for interacting with a medical monitoring device would be desirable.

BRIEF DESCRIPTION OF THE DRAWINGS

Advantages of the invention may become apparent upon reading the following detailed description and upon reference to the drawings in which:

FIG. **1** is a diagrammatical representation of a pulse oximeter featuring an integral microphone in accordance with one embodiment of the present invention;

FIG. **2** is a diagrammatical representation of a pulse oximeter featuring an external microphone in accordance with one embodiment of the present invention;

FIG. **3** is a block diagram of a medical device configured for voice control in accordance with one embodiment of the present invention;

FIG. **4** is a flow chart illustrating an exemplary technique for processing a voice command in accordance with one embodiment of the present invention;

FIG. **5**A illustrates an exemplary operating room employing a medical device configured for voice control in accordance with one embodiment of the present invention;

FIG. **5**B illustrates an enlarged view of a caregiver employing a medical device configured for voice control in accordance with one embodiment of the present invention;

FIG. **6** is a flow chart illustrating an exemplary technique for setting up a patient record in a medical device in accordance with one embodiment of the present invention;

FIG. **7** is a flow chart illustrating an exemplary technique for training a voice system in a medical device in accordance with one embodiment of the present invention;

FIG. **8** is a block diagram of a medical device configured to broadcast voice alerts in accordance with one embodiment of the present invention;

FIG. **9** is a flow chart illustrating an exemplary technique for setting up a voice alert in accordance with one embodiment of the present invention; and

FIG. **10** is a block diagram illustrating an exemplary technique for broadcasting a voice alert in accordance with one embodiment of the present invention.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

One or more specific embodiments of the present invention will be described below. In an effort to provide a concise description of these embodiments, not all features of an actual implementation are described in the specification. It should be appreciated that in the development of any such actual implementation, as in any engineering or design project, numerous implementation-specific decisions must be made to achieve the developers' specific goals, such as compliance with system-related and business-related constraints, which may vary from one implementation to another. Moreover, it should be appreciated that such a development effort might be complex and time consuming, but would nevertheless be a routine undertaking of design, fabrication, and manufacture for those of ordinary skill having the benefit of this disclosure.

Turning initially to FIG. **1**, an exemplary pulse oximeter featuring an integral microphone in accordance with one embodiment is illustrated and generally designated by the reference numeral **10**. The pulse oximeter **10** may include a main unit **12** that houses hardware and/or software configured to calculate various physiological parameters. As illustrated, the main unit **12** may include a display **14** for displaying the calculated physiological parameters, such as oxygen saturation or pulse rate, to a caregiver or patient. In alternate embodiments, as described in further detail below, the display **14** may be omitted from the main unit **12**.

The pulse oximeter **10** may also include a sensor **16** that may be connected to a body part (e.g., finger, forehead, toe, or earlobe) of a patient or a user. The sensor **16** may be configured to emit signals or waves into the patient's or user's tissue and detect these signals or waves after dispersion and/or reflection by the tissue. For example, the sensor **16** may be configured to emit light from two or more light emitting diodes ("LEDs") into pulsatile tissue (e.g., finger, forehead, toe, or earlobe) and then detect the transmitted light with a light detector (e.g., a photodiode or photo-detector) after the light has passed through the pulsatile tissue.

As those of ordinary skill in the art will appreciate, the amount of transmitted light that passes through the tissue generally varies in accordance with a changing amount of blood constituent in the tissue and the related light absorption. On a beat-by-beat basis, the heart pumps an incremental amount of arterial blood into the pulsatile tissue, which then drains back through the venous system. The amount of light that passes through the blood-perfused tissue varies with the cardiac-induced cycling arterial blood volume. For example, when the cardiac cycle causes more light-absorbing blood to be present in the tissue, less light travels through the tissue to strike the sensor's photo-detector. These pulsatile signals allow the pulse oximeter **10** to measure signal continuation caused by the tissue's arterial blood, because light absorption from other tissues remains generally unchanged in the relevant time span.

In alternate embodiments, the sensor **16** may take other suitable forms beside the form illustrated in FIG. **1**. For example, the sensor **16** may be configured to be clipped onto a finger or earlobe or may be configured to be secured with tape or another static mounting technique. The sensor **16** may be connected to the main unit **12** via a cable **18** and a connector **20**.

The pulse oximeter **10** may also include an integral microphone **22**. As will be described further below, the integral microphone **22** may be configured to receive voice commands from a caregiver or user that can be processed into commands for the pulse oximeter **10**. Although FIG. **1** illustrates the integral microphone **22** as being located on a front façade of the main unit **12**, it will be appreciated that in alternate embodiments, the integral microphone **22** may be located at another suitable location on or within the main unit **12**.

The pulse oximeter **10** may also include a speaker **23**. As will be described further below, the speaker **23** may be configured to broadcast voice alerts or other suitable types of alerts to a caregiver or user. Although FIG. **1** illustrates the speaker **23** as being located on a side façade of the main unit **12**, it will be appreciated that in alternate embodiments, the speaker **23** may be located at another suitable location on or within the main unit **12**.

Turning next to FIG. **2**, another embodiment of the exemplary pulse oximeter **10** featuring an external microphone and speaker in accordance with one embodiment is illustrated. For simplicity, like reference numerals have been used to designate those features previously described in regard to FIG. **1**. As illustrated, the pulse oximeter **10** of FIG. **2** also includes the main unit **12**, the screen **14**, the sensor **16**, the cable **18**, and the connector **20**. However, in place of or in addition to the integral microphone **22**, the pulse oximeter **10** illustrated in FIG. **2** may also include an audio connector **24** suitable for coupling a headset **26** to the main unit **12**.

As illustrated in FIG. **2**, the headset **26** may include one or more speakers **28** and an external microphone **30**. As will be described further below, the one or more external speakers **28** may be employed by the pulse oximeter **10** to broadcast voice alerts or other suitable alerts to a caregiver or user. In addition, the external microphone **30** may be employed to receive voice commands for the pulse oximeter **10**, as described further below.

FIG. **3** is a block diagram of an exemplary medical device **40** configured for voice control in accordance with one embodiment. For simplicity, like reference numerals have been used to designate those features previously described with regard to FIGS. **1** and **2**. In one embodiment, the pulse oximeter **10** set forth in FIGS. **1** and/or **2** may comprise the medical device **40**. As illustrated in FIG. **3**, the medical device **40** may include a plurality of modules (blocks **41-52**). These modules may be hardware, software, or some combination of hardware and software. Additionally, it will be appreciated that the modules shown in FIG. **3** are merely one exemplary embodiment and other embodiments can be envisaged wherein the module functions are split up differently or wherein some modules are not included or other modules are included.

As illustrated in FIG. **3**, the medical device **40** may include a voice receiver **41**. The voice receiver **41** may include any suitable form of microphone or voice recording device, such as the integral microphone **22** (as illustrated in FIG. **1**) or the external microphone **30** (as illustrated in FIG. **2**). As those of ordinary skill in the art will appreciate, the voice receiver **41** may be configured to receive a voice (i.e., an acoustic wave) and to convert the voice into an electronic analog waveform.

The voice receiver **41** may be configured to transmit the analog waveform to a voice sampling system **42**. The voice sampling system **42** may be configured to sample the analog waveform to create digital voice data. For example, in one embodiment, the voice sampling system **42** may be configured to sample the electronic analog waveform 16,000 times per second to create a digital waveform of pulse amplitudes. In alternate embodiments, other suitable sampling techniques may be employed.

The voice processing system **44** may be configured to receive the digital waveform from the voice sampling system **42** and to convert the digital waveform into frequencies that can be recognized by a speech recognition system **46**. In one embodiment, the voice processing system **44** may be configured to perform a fast fourier transform on the incoming digital waveform to generate a plurality of frequencies. The voice processing system **44** may then transmit the plurality of frequencies to the speech recognition system **46**.

The speech recognition system **46** may be pre-populated or programmed with a plurality of frequency combinations that are associated with commands for the medical device **40**. For example, frequencies combinations associated with the voice command "turn off alarm" may be associated with a command for the medical device **40** to silence an alarm. As mentioned above, in one embodiment, the particular frequency combinations may be pre-programmed or pre-configured. However, in alternate embodiments, the frequency combinations may be programmed into the speech database via a voice training system **48**, which will be described in greater detail below.

In addition, the speech recognition system **46** may also be coupled to a medical language model **50**. The medical language model **50** may be programmed with a plurality of command combinations that are prevalently used in controlling the medical device **40**. For example, if the medical device **40** were an oximeter, such as the pulse oximeter **10**, the medical language model **50** may store command combinations such as "turn oximeter off," "turn alarm off," "adjust volume," "pause alarms," and so-forth. In this way, the medical language model **50** may assist the speech recognition system **46** in determining the medical command associated with a particular voice command.

More specifically, in one embodiment, the medical language model **50** may assist the speech recognition system **46** in determining the proper medical command when the speech recognition system **46** is able to recognize some portion but not all of a voice command. For example, if the speech recognition system **46** is able to recognize the first and third words of the medical command "turn off alarms," but is unable to recognize the second word, the speech recognition system **46** may search the medical language model **50** for command combinations matching the recognized terms (i.e., "turn" and "alarms"). Because the medical language model **50** may be programmed with only those commands relevant to the operation of the medical device **40**, the medical language model **50** enables the successful recognition of medical commands that would otherwise be unrecognizable by conventional, generic voice recognition systems. The medical language model **50** may be preprogrammed, may be programmed through the voice training system **48**, or may be programmed via an external computer (not shown).

Upon recognizing a voice command as a command for the medical device **40**, the speech recognition system **44** may be configured to transmit the command to a pulse medical device system **52**. As will be appreciated by those with ordinary skill in the art, the medical device control system **52** may be configured to control the medical device. For example, if the medical device **40** were the pulse oximeter **10**, the control system **52** would be configured to control the main unit **12** as well as the sensor **16** to produce physiological monitoring results and/or alarms, which may be transmitted to the display **14** or the speaker **23**.

Turning next to FIG. **4**, a flow chart illustrating an exemplary technique for processing a voice command in accordance with one embodiment is illustrated and generally designated by a reference numeral **60**. In one embodiment, the technique **60** may be employed by the medical device **40** (as illustrated in FIG. **3**) or the pulse oximeter **10** (as illustrated in FIGS. **1** and **2**). It will be appreciated, however, that the technique **60** may also be employed by any other suitable type of medical device including, but not limited to, other forms of monitors, respirators, or scanners.

As illustrated by block **62** of FIG. **4**, the technique **60** may begin by receiving a voice (i.e., a portion of spoken audio). For example, in one embodiment, the pulse oximeter **10** may receive the voice via the microphone **23** or the microphone **30**. After receiving the voice, the technique **60** may include processing the received voice, as indicated in block **64**. In one embodiment, processing the received voice may include converting the received voice into one or more frequencies that can be recognized by a speech recognition system, such as the speech recognition system **46** illustrated in FIG. **3**.

The technique **60** may also include comparing the processed voice with a speech database and/or a medical language model, as indicated by blocks **66** and **68**, and as described above with regard to FIG. **3**. For example, in one embodiment, blocks **66** and **68** may include comparing the processed voice to a speech database within the speech recognition system **46** and/or the medical language model **50**.

After performing one or more of these comparisons, the technique **60** may involve identifying a medical device command associated with the processed voice based upon the one or more of the comparisons, as indicated by block **70**. For example, if comparisons to the speech database and/or the medical language model indicate that the processed voice is a command to "turn off alarms," then technique **60** may involve identifying the medical device command as a command to turn off the medical device's alarms.

Next, after identifying the medical device command, the technique **60** may include prompting a user (e.g., the caregiver) to confirm the new patient information was correctly determined, as indicated by block **72**. For example, in one embodiment, the pulse oximeter **10** may display the identified command on the display **14** and prompt the user to confirm the correctness of the identified command. If the user does not confirm the command (block **72**), the technique **60** may cycle back to block **62** (see above) and re-prompt the user for the new patient information. If, however, the user confirms the command, the technique may execute the command, as indicated by block **74**. For example, in one embodiment, the user may confirm the command by speaking the word "yes" or the word "execute" in response to the displayed command.

As described above, the pulse oximeter **10** and/or the medical device **40** may be employed in a variety of suitable medical procedures and/or environments. For example, FIG. **5**A illustrates an exemplary operating room setting **80** employing the pulse oximeter **10** in accordance with one embodiment. As illustrated in FIG. **5**A, the operating room **80** may include a first caregiver **82***a*, a second caregiver **82***b*, and a patient **84**. In addition, the operating room **80** may also include an operating table **86** and the pulse oximeter **10**.

As illustrated, the caregiver **82***b* may employ and/or interact with the pulse oximeter **10** by wearing the headset **26**. As highlighted in FIG. **5**B, which illustrates an enlarged view of the caregiver **82***b*, the caregiver **82***b* may place the speaker **28** over his or her ear and place the external microphone **30** over his or her mouth. In this way, the caregiver **82***b* may receive alerts and issue commands from and to the main unit **12** via the headset **26**. Advantageously, the functionality enables the main unit **12** to be placed at a remote location in the operating room **80** such that the main unit **12** does not crowd the medical procedure taking place in the operating room **80**. However, those with ordinary skill in the art will appreciate that the embodiment set forth in FIGS. **5**A and **5**B is merely exemplary, and, as such, not intended to be exclusive. Accordingly, in alternate embodiments, the pulse oximeter **10** and/or the medical device **40** may be employed in any one of a number of suitable medical environments.

As described above, the pulse oximeter **10** and/or the medical device **40** may be configured to receive voice commands. Additionally, however, the pulse oximeter **10** and/or the medical device **40** may also be configured to enable entry of patient information by voice. For example, FIG. **6** is a flow chart illustrating an exemplary technique **90** for setting up a patient record in a medical device in accordance with one embodiment. In one embodiment, the technique **90** may be executed by the pulse oximeter **10** and/or the medical device **40**.

As indicated by block **92** of FIG. **6**, the technique **90** may begin by entering a new patent setup mode, as indicated by block **92**. Next, the technique **90** may involve prompting a user for new patient information, as indicated by block **94**. In one embodiment, prompting the user for new patient information may include displaying a message to the user on the display **14** (see FIGS. **1**-**3**). Alternatively, prompting the user may involve an audio or voice prompt, as described further below, or another suitable form of user notification.

Next, the technique **90** may include receiving audio corresponding to the new patient information, as indicated by block **96**. In one embodiment, audio corresponding to the new patient information may be received over the internal microphone **22** and/or the external microphone **30**. For example, the external microphone **30** may receive patient information, such as patient name, age, and so-forth from the caregiver **82***b* wearing the headset **26**. After receiving the audio corresponding to the new patient information, the technique **90** may involve determining the new patient information from the received audio, as indicated by block **98**. In one embodiment, determining the new patient information may include processing the received audio and comparing the received audio to a speech database and/or medical language model, as described above with regard to FIGS. **3** and **4**.

After determining the new patient information from the received audio, the technique **90** may include prompting a user (e.g., the caregiver **82***b*) to confirm the new patient information was correctly determined, as indicated by block **100**. For example, in one embodiment, the pulse oximeter **10** may display the determined patient information on the display **14** and prompt the user to confirm the correctness of the determined patient information with a voice command (e.g., "correct," "yes," and so-forth). If the user does not confirm the new patient information (block **102**), the technique **90** may cycle back to block **94** (see above) and re-prompt the user for the new patient information.

Alternatively, if the user does confirm the determined new patient information, the technique **90** may include storing the new patient information, as indicated by block **104**. For example, in one embodiment, storing the new patient information may include storing the patient's name, age, and so-forth in a memory located within the pulse oximeter **10** and/or the medical device **40**.

As described above, one or more embodiments described herein is directed towards a medical device configured to receive voice commands. Accordingly, FIG. **7** illustrates a technique **110** that may be employed to train a voice system in a medical device in accordance with one embodiment. In one embodiment, the technique **110** may be employed by the pulse oximeter **10** and/or the medical device **40**. More specifically, in one embodiment, the technique **110** may be executed by the voice training system **48** of FIG. **3**. However, it will be appreciated, that in alternate embodiments, other suitable medical devices may employ the technique **110**.

As illustrated by block **112** of FIG. **7**, the technique **110** may begin by entering a training mode. In one embodiment, the medical device **40** may be configured to enter a training mode in response to a depressed button or a sequence of depressed buttons on the medical device **40**. Alternatively, in other embodiments, the pulse oximeter **10** and/or the medical device **40** may be configured to enter the training mode in response to a voice command and/or other suitable form of command or instruction.

After entering the training mode, the technique **110** may include prompting a user with a medical device training routine, as indicated by block **114**. The medical device training routine may involve displaying one or more medical device specific words, phrases, or commands on the display **14**. For example, the pulse oximeter **10** may be configured to display commands such as "turn off alarms," "turn down volume," "show pleth," or any other suitable voice command or instruction.

After prompting the user, as described above, the technique **110** may include recording a response to the training routine, as indicated by block **116**. For example, the pulse oximeter **10** and/or the medical device **40** may be configured to record the response to the training routine via the external microphone **30**. After recording the response to the training routine, the technique **110** may include storing the response in a speech database, such as the speech database within the speech recognition system **46**. After storing the response in the speech database, the technique **110** may cycle back to block **114** and repeat the training routine with additional words, phrases, or comments. In one embodiment, medical device **40** may be configured to cycle through blocks **114**, **116**, and **118** for each of a predefined group of words and instructions stored within the voice training system **48**.

Turning next to another embodiment, FIG. **8** is a block diagram of a medical device **130** configured to broadcast voice alerts in accordance with one embodiment. As those of ordinary skill in the art will appreciate, conventional medical devices are configured to use buzzes and/or beeps to indicate medical alerts or alarms (hereafter referred to collectively as "alerts"). In addition to disturbing patients and medical practitioners (and possibly breaking a medical professional's concentration), these buzzes and beeps typically provide no other useful information to a listener other than indicating the presence of an alert condition. Advantageously, the medical device **130** illustrated in FIG. **8** is configured to produce custom voice alerts that can advantageously provide detailed information about the alert conditions while at the same time being less jarring and/or abrasive than traditional medical device alerts.

The medical device **130** may include a voice receiver **132**, such as the microphone **22** or the microphone **30** (FIGS. **1**-**2**). As will be appreciated, the voice receiver **132** may be configured to receive audio patterns that may be employed to create voice alerts. The medical device **130** may also include a voice recording system **134** that may be configured to receive audio from the voice receiver **132** and to record the received audio.

The voice recording system **134** may be coupled to a medical device control system **136** that may be configured to receive the recorded audio and to store or play it, when appropriate, to produce voice alerts. For example, the medical device control system **136** may be configured to play an appropriate voice alert over a speaker **140**. In addition, the medical device control system **136** may be coupled to a display **142**. As will be appreciated, the display **142** may be configured to display instructions to a user during setup of the voice alerts as well as for other suitable user notifications.

Further, the medical device control system **136** may also be coupled to a storage medium **144**. In one embodiment, the storage medium **144** is configured to store the recorded audio in an indexed format, such as a look-up table, link list, and so-forth, such that a portion of recorded audio may be associated with one or more alert conditions. As such, in this embodiment, the medical device control system **136**, upon detecting an alert condition, may access the stored portion of recorded audio corresponding to the alert condition and then broadcast the portion of audio over the speaker **130**.

As illustrated, the medical device **130** may also include a network interface **146**. The network interface **146** may be configured to enable the medical device control system **136** to communicate with other computers or computerized devices over a network. In this capacity, the network interface **146** may allow the medical device control system **136** to download and/or upload portions of audio for use as voice alerts.

As described above, one or more of the embodiments set forth herein may be directed towards a medical device configured to produce voice alerts. Accordingly, FIG. **8** is a flow chart illustrating an exemplary technique **150** for setting up a voice alert in accordance with one embodiment. As such, in one embodiment, the technique **150** may be executed by the medical device **130**.

As illustrated by block **152** of FIG. **9**, the technique **150** may begin by entering a voice alert setup mode. In various embodiments, entering a voice alert setup mode may be triggered by a voice command to the medical device **130**, by physically manipulating one or more buttons on the medical device **130**, or by another suitable technique. After entering the voice alert setup mode, the technique **150** may include prompting a user with a name of an alert condition. In one embodiment, the medical device **130** may prompt a user with a name of the alert condition by displaying the name of the alert condition on the display **142**.

Next, the technique **150** may include recording a voice alert corresponding to the prompted alert condition. More specifically, in response to the prompt on the display **142**, a user would speak the voice alert, which would subsequently be recorded as part of the technique **150**. After recording the voice alert, technique **150** may include storing the voice alert (block **158**) and associating the stored voice alert with the alert condition (block **160**). For example, in one embodiment, the voice alert may be stored in the storage medium **144** and the medical device control system **136** may be configured to associate the stored voice alert with one or more of its alert conditions.

As described above, medical device **130** may be configured to broadcast voice alerts. Accordingly, FIG. **10** is a flow chart illustrating an exemplary technique **170** for broadcasting a voice alert in accordance with one embodiment. As shown, the technique **170** may begin by identifying an alert condition in the medical device **130**. For example, in one embodiment, the medical device control system **136** may be configured to identify an alert condition, such as signal or power loss, as indicated by block **172**.

Upon identifying the alert condition, the technique **170** may include locating a voice alert associated with the alert condition. For example, in one embodiment, the medical device control system **136** may locate a voice alert stored in the storage medium **144** that is associated with the alert condition. Lastly, the technique **170** may include broadcasting the voice alert, as indicated by block **176**. For example, in one embodiment, the medical device control system **136** may be configured to broadcast the voice alert over the speaker **140**.

While the invention may be susceptible to various modifications and alternative forms, specific embodiments have been shown by way of example in the drawings and have been described in detail herein. However, it should be understood that the invention is not intended to be limited to the particular forms disclosed. Rather, the invention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the following appended claims. Indeed, the present techniques may not only be applied to pulse oximeters, but also to other suitable medical devices. For example, the embodiments set forth herein may also be employed in respirators, ventilators, EEGs, medical cutting devices, and so-forth.

What is claimed is:

1. A pulse oximeter comprising:

a speech recognition system configured to:

receive a processed voice of a person proximate to the speech recognition system;

compare the processed voice to a speech database;

identify a command for the pulse oximeter corresponding to the processed voice based on the comparison; and

execute the identified pulse oximeter command without the person physically touching the pulse oximeter.

2. The pulse oximeter, as set forth in claim **1**, comprising a tangible machine readable medium comprising a medical language model, wherein the speech recognition system is configured to identify the command based on the medical language model.

3. The pulse oximeter, as set forth in claim **2**, wherein the medical language model comprises a plurality of commands for the pulse oximeter.

4. The pulse oximeter, as set forth in claim **1**, comprising a voice training system configured to populate the speech database.

5. The pulse oximeter, as set forth in claim **1**, comprising a voice processing system configured to process a received voice of the person proximate to the speech recognition system to create the processed voice.

6. The pulse oximeter, as set forth in claim **5**, comprising a headset, wherein the voice processing system is configured to receive the received voice from the headset, wherein the headset is proximate to the pulse oximeter.

7. The pulse oximeter, as set forth in claim **5**, comprising an integral microphone, wherein the voice processing system is configured to receive the voice of the person proximate to the speech recognition system from the integral microphone.

8. A method comprising:

receiving a processed voice of a person proximate to a pulse oximeter;

comparing the processed voice to a speech database disposed in the pulse oximeter;

identifying a command for the pulse oximeter corresponding to the processed voice based on the comparison; and

executing the identified pulse oximeter command without the person physically touching the pulse oximeter.

9. The method, as set forth in claim **8**, comprising comparing the received processed voice to an oximeter language model.

10. A pulse oximeter comprising:

a control system configured to:

identify an alert condition for the pulse oximeter;

locate a voice alert corresponding to the alert condition; and

broadcast the voice alert over a speaker to a person proximate to the pulse oximeter.

11. The pulse oximeter, as set forth in claim **10**, comprising a voice recording system configured to record the voice alert.

12. The pulse oximeter, as set forth in claim **11**, comprising a storage medium, wherein the control system is configured to store the recorded voice alert on the storage medium.

13. The pulse oximeter, as set forth in claim **10**, comprising a network interface, wherein the control system is configured to download the voice alert over the network interface.

14. A method of broadcasting voice alerts from a pulse oximeter, the method comprising:

prompting a user proximate to the pulse oximeter with a name of a pulse oximeter alert condition;

recording a voice alert of the user in the pulse oximeter;

associating the recorded voice alert with the pulse oximeter alert condition; and

broadcasting the recorded voice alert to a person proximate to the pulse oximeter when the alert condition is detected.

15. The method, as set forth in claim **14**, comprising storing the voice alert in a memory disposed in the pulse oximeter.

16. A method for broadcasting a voice alert from a pulse oximeter, the method comprising:

identifying an alert condition for the pulse oximeter;

locating a voice alert corresponding to the alert condition; and

broadcasting the voice alert over a speaker integral to the pulse oximeter.

17. The method, as set forth in claim **16**, wherein locating the voice alert comprises locating a recorded voice alert in a storage medium coupled to the pulse oximeter.

18. The method, as set forth in claim **16**, wherein locating the voice alert comprises locating a recorded voice alert on a network via a network interface.

19. The method, as set forth in claim **16**, wherein identifying the alert condition comprises identifying a loss of signal from a sensor placed on a patient proximate to the pulse oximeter.

20. A method for programming a pulse oximeter with patient information, the method comprising:

prompting a user proximate to the pulse oximeter for new patient information;

receiving audio corresponding to the new patient information using the pulse oximeter; and

determining the new patient information from the audio using the pulse oximeter.

21. The method, as set forth in claim **20**, comprising:

prompting the user to confirm the determined new patient information; and

if the user confirms the new patient information, storing the new patient information in the pulse oximeter.

22. A medical device comprising:

one or more controls on the medical device, wherein activation of a respective control by physical touch executes a corresponding medical device command;

a speech recognition system configured to:

receive a processed voice of a person proximate to the speech recognition system;

compare the processed voice to a speech database;

identify a command for the medical device corresponding to the processed voice based on the comparison; and

execute the identified medical device command without the person physically touching the one or more controls.

23. The medical device, as set forth in claim **22**, comprising a tangible machine readable medium comprising a medical language model, wherein the speech recognition system is configured to identify the command based on the medical language model.

24. The medical device, as set forth in claim **23**, wherein the medical device comprises a pulse oximeter and the medical language model comprises a plurality of pulse oximeter commands.

25. The medical device, as set forth in claim **23**, wherein the medical language model comprises a plurality of commands for the medical device.

26. The medical device, as set forth in claim **22**, comprising a voice training system configured to populate the speech database.

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